This paper outlines a methodological framework for calculating single-year costs of illness, disability and death. Economic principles used are summarized, and several methodological problems, such as the presence of multiple diseases, gaps in statistical data, and others are presented. Suggestions for the use of these single-year data on illness costs are summarized.

ESTIMATING THE COST OF ILLNESS

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I N recent years a variety of studies and figures relating to the cost of illnesses have been generated in the health field. The methods used range from broad statements of costs with no apparent bases, to detailed, sophisticated economic analyses. The costs are estimated in gross terms, in some instances, to justify categorical program expenditures by emphasizing the economic impact on society of the disease in question. In other cases, the cost estimates have been developed within the rigorous framework of cost-benefit analysis, in which the present cost of a disease serves as a measure of potential benefits derived from programs to control or prevent the disease. Examples of such detailed cost-benefit studies include those by Fein and Weisbrod, and, more recently, Klarman, Mushkin, and the author.[1] In each of these studies, the calculation of the direct medical care expenditures and the value of losses in production output is performed systematically and more or less laboriously.

This paper outlines the problems involved in measuring direct and indirect costs and presents a framework for calculating single-year costs of illness, disability, and death by major category of illness. Presented are data on selected types of health expenditures in 1963 by diagnosis, as well as estimates of total man-years lost and productivity losses resulting from morbidity and mortality in 1963 for each diagnostic category. The final section of this paper deals with suggestions for use of these data.

Measuring Annual Direct Costs of Illnesses

Direct costs of illnesses comprise the expenditures for prevention, detection, treatment, rehabilitation, research, training, and capital investment in medical facilities. In terms of services or type of medical expenditure, direct costs include amounts spent for hospital and nursing home care, physicians and other medical professional services, drugs, medical supplies, research, training, and other nonpersonal services.

For a decade or so the Social Security Administration, US Department of Health, Education, and Welfare, has prepared estimates of public and private expenditures for health and medical care. Data are available on expenditures for health services under specified public programs and by type of payment in the private sector.[2] More

recently, estimates have been prepared by object of expenditure or type of health service, i.e., hospital care, physicians' services, drugs, medical research, construction, and so on.[3]

These annual expenditures for the various health services may also be distributed by type of illness or diagnosis. This procedure would eliminate the possibilities of gross overstatements or underestimates of specific illness costs and would provide meaningful cost estimates in terms of the annual total of health expenditures. The totals derived by piecemeal estimation of illness costs will not approximate the annual outlays for health and medical care because of lack of comparability in definitions, basic data, and methodology employed for each specific illness cost study.

The estimated distribution of 1963 health expenditures for specified health services is presented for the eight diagnostic groups, categorized according to the International Classification of Diseases, Adapted (ICDA). The remaining ten major diagnostic groups identified in the ICDA listing are included in "all other." The allocation of funds by disease is limited in this paper to the following categories of expenditures: hospital and nursing home care; and services of physicians, dentists, and other health professions. Expenditures for these services amounted to $22.5 billion, approximately two-thirds of the total outlay ($34.3 billion) for health and medical care in 1963.[4] The remaining third includes a variety of personal and nonpersonal expenditures. Distribution by disease of amounts spent for medications and supplies presents problems because many specific drugs and appliances are used for a variety of conditions and illnesses. The function of school health programs includes health appraisal, counseling, disease prevention, and control activities in addition to providing emergency service for injury or sudden sickness.[5] Likewise, occupational health emphasizes prevention of illness in addition to emergency care.[6] The proportion of care for emergency services and the types of illnesses treated are not available for the allocation of expenditures for school health and industrial in-plant services.

No attempt was made to allocate expenditures for nonpersonal services, i.e., medical research, construction, government public health activities, voluntary health agencies, and the net cost of insurance. These are areas for future work. Questions may be raised as to whether the distribution of medical research expenditures by disease would be meaningful because (1) much of the current medical research is noncategorical in nature—primarily in the basic medical sciences, and (2) often research results are applicable to more than one disease.

Estimating Procedure*

In general, the expenditures were distributed on the basis of the utilization of the specific type of service. For example, the distribution by primary diagnosis (the final diagnosis of the condition for which the patient was admitted) of the total days of care in 1963, in a sample group of nonfederal short-term general hospitals was applied to the total expenditures for care in these hospitals. The assumption here was that the costs of a day of hospital care for each type of disease are the same, which is obviously not the case. In the study of the costs of cardiovascular diseases and cancer, average daily charges in nonfederal short-term general hospitals in 1962 amounted to $27.50 for rheumatic fever patients and $53.11 for patients with congenital heart

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* The detailed estimating procedures for allocation of funds by disease and for calculation of the economic value of lost output may be obtained from the author.

malformations, reflecting the differences in treatment of hospitalized patients with these diagnoses.[7] Likewise, considerable variations in average daily charges were also found by cancer site.[8] Given a considerable amount of time and additional staff, this same procedure could have been followed for all the diagnostic groups. Because of the limitations in both these areas, approximations were employed throughout, with full recognition that further refinement of the data can and should be made.

The primary diagnosis was used as the basis for distributing costs. The presence of associated conditions or multiple diagnoses will affect the utilization of services and costs. Referring again to the aforementioned study, it was estimated that roughly 2.5 extra days of hospital care were attributable to the presence of cardiovascular conditions among patients with primary diagnoses in other disease categories. In dollar terms, this amounted to more than $100 million in 1962.[9] The application of this procedure to each disease would result in double counting and overstatement of the national health expenditures. The presence of multiple diseases also presents special problems in estimating indirect costs of illness. These will be discussed further in a later section of this report.

Findings—Direct Costs

The allocation of funds by type of service and disease, as shown in Table 1 are of considerable interest. Of the total $22.5 billion, expenditures for diseases of the digestive system ranked highest, totaling $4.2 billion, or 18.5 per cent of the total. Included in this diagnostic group are expenditures for dental diseases, including all of the private consumer expenditures for dental care and amounts spent under public programs for services of dentists in private practice. Expenditures of $2.4 billion for mental disorders ranked second, with 10.7 per cent of the total. Hospital and nursing home care and professional medical services for patients with diseases of the circulatory system amounted to $2.3 billion, the third highest expenditure category. These three diagnostic groups—diseases of the digestive system, mental disorders, and diseases of the circulatory system—comprised almost two-fifths of the total expenditures. The remaining expenditures were distributed among the various diagnostic groups, with expenditures for seven diagnoses ranging from $1.2 to $1.8 billion. Almost $1 billion was spent for special conditions and examinations without sickness, mainly consisting of physicians' services. Not included in these estimates are additional expenditures by public health departments for immunization programs, well-baby clinics, and other preventive health services.

There are striking differences between the various categories of expenditures in terms of the diagnostic groups. Almost 18 per cent of the $11.6 billion of expenditures for hospital care were for mental disorders. By contrast, only 3.6 per cent of the expenditures for nursing home care, 4.1 per cent of the physicians' services, and 4.3 per cent of nursing care were for mental disorders. For nursing home care, the proportion was highest for diseases of the circulatory system, comprising one-fourth of the total expenditures. As expected, expenditures for diseases of the nervous system and sense organs and symptoms, senility, and ill-defined conditions were also relatively high—21.6 and 17.0 per cent, respectively, of the total expenditures for nursing home care. These three major disease categories accounted for almost two-thirds of the total expenditures for nursing home care.

For expenditures for services of physicians in private practice, special condi-

Table 1—National health expenditures: distribution of expenditures for specified health services, by selected diagnoses and type of service, 1963

Diagnosis	Total	Hospital care	Nursing home care	Physicians' services	Dentists' services	Nursing care*	Other professional services†
Amount, total (in millions)	$22,530.0	$11,579.0	$825.0	$6,867.0	$2,369.0	$460.0	$430.0
Per cent, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Neoplasms	5.7	8.7	3.3	3.0	—	8.6	—
Mental, psychoneurotic, and personality disorders	10.7	17.8	3.6	4.1	—	4.3	2.6
Diseases of nervous system and sense organs	6.3	5.9	21.6	7.4	—	10.0	—
Diseases of circulatory system	10.1	11.0	25.1	10.4	—	15.9	—
Diseases of respiratory system	7.0	6.5	—	11.7	—	5.8	—
Diseases of digestive system	18.5	11.5	1.1	5.8	100.0	10.2	—
Diseases of bones and organs of movement	6.3	4.3	6.3	6.6	—	8.5	89.3
Injuries	7.6	8.6	8.8	8.8	—	6.6	—
All other‡	28.0	25.7	30.2	42.2	—	30.0	8.1

* Includes the services of private duty professional nurses in the hospital and home, private duty practical nurses, and visiting nurses.
† Includes the services of podiatrists, physical therapists, clinical psychologists, chiropractors, naturopaths, and Christian Science practitioners.
‡ The breakdown for each major diagnostic category included in "all other" may be obtained from the author for all tables.
NOTE: Totals may not add due to rounding in all tables in this report.

tions and examinations without sickness ranked highest, followed by diseases of the respiratory system, and diseases of the circulatory system. Together, expenditures for these diagnostic groups amounted to $2.4 billion, or 34.9 per cent of the total of $6.9 billion received by physicians in private practice.

Payments for services of special duty and visiting nurses, registered and practical, amounted to approximately $460 million in 1963. Expenditures were highest for nursing care of patients with circulatory diseases.

Other professional services included clinical psychologists, podiatrists, physical therapists, chiropractors and naturopaths, and Christian Science practitioners. All of the expenditures for clinical psychologists were classified as payments for care of patients with mental disorders; services of podiatrists, physical therapists, and chiropractors were assigned to patients with diseases of the bones and organs of movement.

Measuring Annual Indirect Costs of Illnesses

Direct expenditures, as calculated above, do not measure the full economic costs imposed upon the nation by illness, disability, and premature death since they do not include the loss of output to the economy. These losses are labeled indirect costs. As previously indicated, many estimates of the annual indirect costs of illnesses are currently available. The National Health Education Committee prepares an annual report which includes a collection of estimates of the costs of major chronic and crippling illnesses, compiled from many published sources. Estimates are cited for the following: wage losses resulting from days lost from work because of acute and chronic conditions; earnings losses for those who died from arteriosclerotic heart disease and cancer, and their tax revenue losses; annual indirect costs of heart disease, mental illness,

arthritis and rheumatism, and cerebral palsy.[10]

Examination of the reported indirect losses shows a lack of consistency in estimating procedures. Earnings are applied to work-loss days for some diseases; others include only losses associated with institutional care, and still others offer no clear basis for the derived costs. For many illnesses, federal pensions or relief payments and estimated losses in taxes are added to the total. It is clear that a systematic approach is required to estimate the annual indirect losses associated with illnesses, disability, and death.

The estimated distribution of 1963 losses in output resulting from mortality and morbidity are presented for 8 major diagnostic groups. The basic method for calculating the economic value of lost output was to apply prevailing average earnings to the productive time lost by sex and age groups for each major cause of death and major type of illness. Distribution by disease was based on a variety of sources including Vital Statistics, National Health Survey, Social Security disability allowances, and special studies.

The calculation of the annual loss of output resulting from mortality and morbidity involved the application of several principles of economics on which there is some consensus.[11] Several methodological problems arose in the development of the estimated loss of output in a single year by disease. The economic principles used and the methodological problems are summarized below.

Economic Principles Employed

1. *Earnings*—The appropriate measure of output loss for individuals is the year-round, full-time earnings, which include wages and salaries before deductions. The proper measure of expected earnings is the arithmetic average or mean (not the median, which is fre-

quently employed because it is available in published form). Adjustments were made to take cognizance of wage supplements—employer contributions for social insurance, private pensions, and welfare funds.

2. *Employment*—Not everybody would have worked or been productive if death or illness had not interfered. Some are too old, some too young, some unwilling to work, and some unable to find a job. The estimate of losses in output assumes that if it were not for these illnesses or causes of death, persons stricken would have had the same employment experience as persons in the same age and sex groups. Labor force participation rates (proportion of all civilians who are employed or looking for a job) were applied and further adjustments were made for the number who would have been employed under conditions of high employment, defined as 4 per cent unemployment. Without the assumption of high employment, losses due to mortality and disability cannot be isolated from losses due to unemployment.

3. *Housewives' Services*—Housewives' services are estimated at the average earnings of a domestic worker. Although the economic contributions of housewives are not included in the national income accounts, omitting the value of their services in calculations of indirect costs distorts comparisons of costs of illnesses striking primarily one sex.

4. *Transfer Payments and Taxes*—Transfer payments, such as pension and relief payments, are not included here among the costs of disease. Double or triple counting would be involved if a relief payment were added to the estimated loss of earnings by an individual. Further, the relief payments may also be used for medical care treatment, already accounted for in the direct costs. Similarly for tax payments, it would be double counting to add income tax losses to loss of earnings, and triple

counting if the tax receipts were used for public payments for medical care.

5. *Measurement of Intangibles*—Intangible or psychic costs of disease, such as pain and grief, are omitted. These costs do not directly involve a loss of output and are not readily measurable. Several economists feel that ignoring the intangibles may distort the over-all economic and social costs because the implicit assumption is that the economic value of intangible losses is zero.[12]

Methodological Problems

1. *Presence of Multiple Diseases*—As was true of direct costs, the presence of multiple diseases also presented problems for estimating indirect costs. Basic data available from the National Health Survey for measuring losses in output for currently employed persons and for housewives include multiple listing of conditions, with no indication as to the primary cause of work loss. Reported work-loss days associated with acute and chronic conditions were uniformly adjusted downward for each diagnosis to eliminate duplication caused by disability for which more than one disease or condition was mentioned. The same procedure was followed for housewives who reported that more than one condition prevented them from carrying on the major activity of keeping house. The effect is to reduce the loss in output associated with each cause of disability; to have added the multiple conditions would have resulted in overstating the total losses in output for these groups of disabled persons. It is recognized that application of a uniform adjustment factor assumes that all associated conditions are evenly distributed among all diseases which is obviously not the case. For example, heart disease conditions are much more likely than cancer to be associated causes of disability.

2. *Mortality Losses*—For each cause of death the number of persons who

died in 1963 was divided in half prior to adjustment for labor force participation and unemployment rates and the application of earnings. Use of the total number of deaths would have implicitly assumed that all deaths occurred on January 1, an assumption frequently made by those estimating annual costs of deaths from specific illnesses.

3. *Population Groups* — Population groups (by sex and age) whose output losses were measured include the institutional and noninstitutional populations. The former group includes persons in long-term hospitals (mental, tuberculosis, chronic disease hospitals), homes for the aged, and homes and schools for mentally and physically handicapped.[13] The noninstitutional population is classified according to labor force status. Those not in the labor force are further subdivided into the women keeping house and those unable to work because of long-term physical or mental illness.[14] The output losses by diagnosis were measured separately for each of the above population groups.

4. *Gaps in Statistical Data*—The measurement of output losses by major diagnostic groups involved a wide range of assumptions and approximations relating to prevalence of disease. For example the measurement of output losses for those in the labor force was based on the work-loss days as reported by the National Health Survey. Reliance on these data undoubtedly resulted in conservative estimates for some diseases and overstatements for others. Losses for diseases, such as cancer, may be understated because the household respondent can only report the information that the physician gave to the family and the respondent may not have been told the condition or may have misunderstood or forgotten what the physician said. For conditions not medically attended, such as diseases of the respiratory system, the diagnostic information supplied by the respondent

may only indicate a symptom, resulting in a possible overstatement of losses.[15]

Owing to these difficulties of collecting information relating to cancer from the Health Interview Survey, in our previous study we based our estimates of the loss in output for cancer patients on other data.[16] In order to follow a systematic and consistent methodology for measuring output losses for all .diseases in this paper, a single source of diagnostic data was used for each population group and the refinements introduced in the previous study are omitted.

For the 1.8 million noninstitutional persons classified as not in the labor force and unable to work in 1963, the diagnostic distribution was based on that reported for workers receiving disability allowances in 1963.[17] The broad assumption here is that the illness pattern for the 224,229 persons receiving disability allowances is the same as that of the 1.8 million persons unable to work. It is recognized that in the latter group there are a large number of persons who may be suffering from any one of several types of disabling chronic illnesses, such as hay fever, which would not be accounted for because these medical diagnoses are not considered a basis for allowing a period of disability.

Findings—Indirect Costs

1. Mortality Losses

Approximately 1.8 million persons died in 1963 from all causes, 57 per cent were males and 43 per cent females (Table 2). The losses in output resulting from these deaths are equivalent to more than 600,000 man-years, or a total value of $2.7 billion. Of the total man-years lost to productivity, 45 per cent represent losses for males and the remaining 55 per cent are for females. Because of the higher earnings by males, the dollar value of these losses shows a reverse re-

Table 2—Mortality losses: number and distribution of deaths and productivity losses, by selected diagnoses and sex, 1963

Diagnosis	Deaths			Productivity losses by sex					
				man-years lost			indirect costs		
	total	males	females	total	males	females	total	males	females
Amount, total:									
Deaths, man-years lost (in thousands)	1,813.5	1,027.7	785.9	611.2	275.3	335.9	—	—	—
Indirect costs (in millions)	—	—	—	—	—	—	$2,731.0	$1,764.3	$966.7
Per cent, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Neoplasms	16.0	15.2	17.0	17.6	16.7	18.4	17.7	16.9	19.1
Mental, psychoneurotic, and personality disorders	0.3	0.3	0.2	0.3	0.4	0.2	0.4	0.5	0.2
Diseases of nervous system and sense organs	11.9	10.0	14.4	12.5	9.2	15.3	11.0	8.8	14.9
Diseases of circulatory system	43.1	43.8	42.3	45.3	45.4	45.3	44.9	45.2	44.3
Diseases of respiratory system	5.8	6.4	5.0	5.0	5.6	4.4	5.1	5.5	4.4
Diseases of digestive system	4.0	4.1	3.8	4.2	4.6	3.8	4.5	4.8	4.0
Diseases of bones and organs of movement	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.3
Injuries	7.2	8.8	5.1	7.5	11.0	4.6	8.9	11.1	4.8
All other	11.5	11.3	12.0	7.4	7.1	7.7	7.4	7.1	7.9

lationship: 65 per cent for males and 35 per cent for females. Losses among males are for those who would have been in the labor force in 1963 had they not died; among females, losses are mainly for those prevented from housekeeping.

As expected, losses for those who died from circulatory diseases rank highest, accounting for 43 per cent of the deaths and 45 per cent of the productivity losses in man-years and costs. Losses in output for those who died from all forms of neoplasms rank second, accounting for 18 per cent of the total mortality costs. Diseases of the nervous system and sense organs, including stroke, are the third highest causes of deaths and resulting losses in output. Together, these three major diagnostic groups account for 71 per cent of the deaths and a slightly higher proportion (73.6 per cent) of the total losses in output.

The diagnostic distribution of the losses in output for male and female deaths shows some variations. For both sexes, losses are highest for circulatory diseases and neoplasms. For males, losses resulting from death due to injuries and adverse effects of chemical and other external conditions rank third, accounting for 11 per cent of the indirect costs of mortality for males. The corresponding percentage for females is only 5 per cent. For females, the third highest ranking disease losses are for those who died from diseases of the nervous system and sense organs, accounting for 15 per cent of the total.

2. Morbidity Losses—Institutionalized Population

Approximately 1.5 million persons were in institutions in 1963. Their losses are estimated at approximately $5.1 billion, reflecting the value of output of 1.1 million man-years. Of the total institutional costs, almost three-fifths are attributed to persons in mental hospitals. Persons in nursing homes and homes for the aged combined account for one-fourth of the costs. All of the persons in mental hospitals are classified as suffering from mental, psychoneurotic, and personality disorders. In other institutions, there are additional patients whose primary diagnoses are also mental disorders. As a result, the productivity losses for this major diagnostic group are far greater than those for any other diagnosis. Of the $5.1 billion institutional losses, $3.6 billion, or 71 per cent, are attributed to mental disorders.

The number of institutionalized persons and their productivity losses are summarized in Table 3.

Table 3—Morbidity losses—institutionalized population: distribution of persons and productivity losses, by type of institution, 1963

| Type of institution | Institutionalized persons | | Productivity losses | | | |
| | | | man-years lost | | indirect costs | |
	number (000's)	per cent	number (000's)	per cent	amount (millions)	per cent
Total	1,461.9	100.0	1,131.3	100.0	$5,104.3	100.0
Mental hospitals	719.7	49.2	609.3	53.9	2,990.3	58.6
Nursing homes	200.6	13.7	151.1	13.4	534.4	10.5
Homes for the aged	269.1	18.4	201.7	17.8	774.4	15.2
Mentally handicapped*	174.7	12.0	107.5	9.5	494.1	9.7
All other†	97.8	6.7	61.6	5.5	311.0	6.1

* Includes homes and schools.
† Includes tuberculosis hospitals; long-term hospitals, including chronic disease and long-term general hospitals; blind and deaf homes and schools, and physically handicapped homes and schools.

3. Morbidity Losses—Noninstitutional Population

Morbidity losses for the noninstitutional population were estimated for the following population groups: (1) the currently employed, (2) those unable to work because of chronic illness or disability, and (3) women unable to keep house because of illness or disability. (Days lost from school are omitted as they are not considered losses to productivity.) For all the noninstitutional population, total morbidity losses amount to 3.8 million man-years, of which 2.9 million were productive years lost, representing a total of $15.9 billion lost to the economy in 1963.

The productivity losses for the currently employed group, as measured by work-loss days, accounted for approximately three-fifths of the total; in terms of the total years lost, the currently employed group comprises 44 per cent of the total.[18] Those unable to work represent almost half (47 per cent) of the total years lost for the noninstitutional population, but many in this group are too old to work and would not be productive if they had been well. Table 4 summarizes the data.

4. Mortality and Morbidity Losses

Losses in output and indirect costs of mortality and morbidity in 1963 are summarized according to various characteristics: sex, age, and labor force

status. A total of 6.2 million man-years were lost in 1963 due to death or illness. Not all of these years would have been productive. Of this total, three-fourths (4.6 million man-years) were productive years lost, valued at $23.8 billion. Of the 4.6 million man-years lost to productivity, 2.5 million are for males and the remaining 2.1 million are for females. Due to the higher earnings for males, the dollar amounts associated with their losses are considerably higher —$16.9 billion compared with $6.9 billion for females as shown in Table 5.

Combining mortality and morbidity losses shows that mental disorders account for approximately one-fifth of the total costs, followed by circulatory diseases, representing 17 per cent of the total. Respiratory illnesses ranked third. These three major diagnostic groups accounted for approximately half of the man-years lost to productivity and of the value of losses in output for those who died or were ill and disabled in 1963 (Table 6).

The distribution by age of mortality and morbidity losses shows some interesting relationships: a total of 6.2 million man-years were lost in 1963 due to death, illness, and disability. Of this total, those age 45-64 accounted for the highest proportion—36 per cent of the total. The man-years lost for those age 65 and over ranked second, with 31 per

Table 4—Morbidity losses—noninstitutional population: number and distribution of total years lost and productivity losses, by population group, 1963

| | Total years lost | | Productivity losses | | | |
| | | | man-years lost | | indirect costs | |
Population group	number (000's)	per cent	number (000's)	per cent	amount (millions)	per cent
Total	3,833.6	100.0	2,883.6	100.0	$15,937.9	100.0
Currently employed*	1,695.6	44.2	1,695.6	58.8	9,764.1	61.3
Unable to work	1,820.0	47.4	865.0	30.0	5,311.4	33.3
Keeping house*	323.0	8.4	323.0	11.2	862.4	5.4

* All persons in this group are assumed to be productive.

Table 5—Morbidity and mortality losses: number and distribution of total years lost and productivity losses, by sex, 1963

Sex	Total years lost		Productivity losses			
			man-years lost		indirect costs	
	number (000's)	per cent	number (000's)	per cent	amount (millions)	per cent
Total	6,207.3	100.0	4,626.0	100.0	$23,773.1	100.0
Males	3,428.2	55.2	2,552.2	55.2	16,922.9	71.2
Females	2,779.1	44.8	2,073.8	44.8	6,850.3	28.8

cent of the total. The distribution by age of productivity losses shows a different pattern: losses were also highest for those age 45-64, accounting for a larger share of the productivity losses— 39 per cent of the productive man-years lost and 45 per cent of the indirect costs. As expected, productivity losses for the age group 65 and over represent a considerably smaller proportion of the total, reflecting the relatively lower productivity of this age group. These data are summarized in Table 7.

Losses to GNP

To measure the losses to GNP due to death, illness, and disability in one year, the value of output imputed to housewives must be excluded as the economic contributions of housewives are not included in the national income accounts. In 1963, a total of 1.1 million man-years lost are attributed to housewives who died or were too ill to keep house. The imputed value of their losses in output is estimated at $2.9 billion. Almost one-fourth of the productive man-years lost and one-eighth of the indirect costs of mortality and morbidity in 1963 are attributed to women prevented from keeping house as shown in Table 8.

The value of the losses in output amounted to $20.9 billion in 1963 for the potentially productive members of the labor force. On this basis, the GNP in 1963 would have been increased approximately 3.6 per cent, if illness, disability, and death from all diseases had not interfered.

Annual Economic Costs

The annual economic costs—the sum of the direct expenditures for medical care and indirect costs—of mortality and morbidity are summarized for each of the 8 diagnostic categories in Table 9. The total economic costs of illness, disability, and death are estimated at $58 billion in 1963, comprised of the following:

1. $34.3 billion spent for medical care, services and supplies. Of this total, $22.5 billion, or two-thirds, were distributed among the major diagnostic groups. The remaining $11.7 billion includes expenditures for a variety of personal and nonpersonal services, which could not be allocated to specific diseases.

2. $23.8 billion lost to the economy in 1963 due to premature death, illness, and disability from all diseases. Mortality losses account for 11.5 per cent of the total, and the remaining 88.5 per cent are morbidity losses.

Of the $46.3 billion total economic costs distributed among the major diagnostic groups, $7.0 billion, or 15.2 per cent, represent the costs of mental, psychoneurotic, and personality disorders reflecting the high direct and indirect institutional costs for the mentally ill. Costs of diseases of the circulatory system rank second, totaling $6.4 billion.

Table 6—Mortality and morbidity losses: distribution of productivity losses, by selected diagnoses and age, 1963

Diagnosis	Productivity losses by age group									
	man-years lost					indirect costs				
	all ages	under 25	25–44	45–64	65 and over	all ages	under 25	25–44	45–64	65 and over
Amount, total										
Man-years lost (in thousands)	4,626.0	319.7	1,258.6	1,817.8	1,229.8	—	—	—	—	—
Indirect costs (in millions)	—	—	—	—	—	$23,773.1	$1,113.4	$7,143.1	$10,733.5	$4,783.2
Per cent, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Neoplasms	5.6	3.5	3.7	6.4	7.1	5.6	3.6	3.7	6.3	7.3
Mental, psychoneurotic, and personality disorders	20.2	21.7	25.5	19.4	15.6	19.5	21.9	25.5	17.7	14.0
Diseases of nervous system and sense organs	8.4	6.4	5.2	6.8	14.4	7.7	6.2	4.8	6.8	14.2
Diseases of circulatory system	18.0	4.2	8.1	18.7	30.8	17.4	3.7	7.6	19.2	31.3
Diseases of respiratory system	12.7	19.0	16.7	13.8	5.3	13.9	19.3	17.4	14.3	6.5
Diseases of digestive system	5.2	6.2	6.1	6.0	3.0	5.7	6.2	6.3	6.2	3.3
Diseases of bones and organs of movement	5.0	3.1	4.6	5.9	4.8	5.2	2.9	4.5	6.0	5.0
Injuries	7.7	14.1	10.8	6.7	4.4	8.6	15.0	12.6	7.2	4.5
All other	17.1	21.5	19.4	16.6	14.7	16.4	21.2	17.7	16.1	13.9

Table 7—Morbidity and mortality losses: number and distribution of total years lost and productivity losses, by age, 1963

| Age group | Total years lost | | Productivity losses | | | |
| | | | man-years lost | | indirect costs | |
	number (000's)	per cent	number (000's)	per cent	amount (millions)	per cent
Total	6,207.3*	100.0	4,626.0	100.0	$23,773.1	100.0
Under 25	571.0	9.2	319.7	6.9	1,113.4	4.7
25–44	1,461.2	23.5	1,258.6	27.2	7,143.1	30.0
45–64	2,237.4	36.0	1,817.8	39.3	10,733.5	45.1
65 and over	1,937.4	31.2	1,229.8	26.6	4,783.2	20.1

* Total includes 628 deaths, or 314 man-years lost during the year, for which the age at death was unknown.

Costs of diseases of the digestive and respiratory systems rank third and fourth, respectively. Together, the above four major diagnostic groups accounted for $23.8 billion, representing more than half the total economic costs of illness, disability, and death from all causes.

Table 10 summarizes the economic costs in 1963 of illness, disability, and death, with and without the imputed value of output for housewives.

Uses of Diagnostic Cost Data

Detailed data of direct and indirect costs of morbidity and mortality for 8 major diagnostic groups have been presented for a single year, 1963. Several suggestions for use and application of these data together with the problems involved are presented below.

First, these single-year illness cost estimates, adjusted for the exclusion of the value of output imputed to housewives, may be related to GNP to indicate how much larger it might have been under certain assumptions (such as high employment), if morbidity and mortality in a given year had not interfered.

Second, these data can serve as benchmarks for estimating the annual costs of specific illnesses. Many voluntary and public agencies concerned with specific diseases will continue to publish cost estimates to further programs of research and control. With the availability of single-year cost estimates for the major disease categories, it would be possible to assess the validity of costs for the various illnesses included within the ma-

Table 8—Morbidity and mortality losses: number and distribution of productivity losses, by labor force status, 1963

| Labor force status | Productivity losses | | | |
| | man-years lost | | indirect costs | |
	number (000's)	per cent	amount (millions)	per cent
Total	4,626.0	100.0	$23,773.1	100.0
Labor force	3,547.1	76.7	20,892.6	87.9
Keeping house	1,078.8	23.3	2,880.6	12.1

Table 9—Annual economic costs: distribution of direct expenditures and indirect costs of morbidity and mortality, by selected diagnoses, 1963

Diagnosis	Total	Direct expenditures*	Indirect costs		
			total	mortality	morbidity
Amount, total (in thousands)	$46,303.1	$22,530.0	$23,773.1	$2,731.0	$21,042.2
Per cent, total	100.0	100.0	100.0	100.0	100.0
Neoplasms	5.6	5.7	5.6	17.7	4.0
Mental, psychoneurotic, and personality disorders	15.2	10.7	19.5	0.4	22.0
Diseases of nervous system and sense organs	7.0	6.3	7.7	11.0	7.2
Diseases of circulatory system	13.8	10.1	17.4	44.9	13.9
Diseases of respiratory system	10.6	7.0	13.9	5.1	15.0
Diseases of digestive system	11.9	18.5	5.7	4.5	5.8
Diseases of bones and organs of movement	5.7	6.3	5.2	0.2	5.8
Injuries	8.1	7.6	8.6	8.9	8.6
All other	21.9	28.0	16.4	7.4	17.8

* Direct expenditures for specified health services, including hospital and nursing home care, services of physicians, dentists, nurses, and other health professional personnel; excluded are several types of personal and nonpersonal expenditures, amounting to $11.7 billion, which could not be distributed among the major diagnostic categories.

jor diagnostic groups. For example, diseases of the bones and organs of movement include a variety of illnesses such as arthritis and rheumatism, osteomyelitis and other diseases of bone, joint, and musculoskeletal system. If annual cost estimates are required for arthritis and rheumatism, the total direct and indirect cost of $2.7 billion in 1963 for the major category, as presented in this report, may be used as a guide for the determination of the portion of the single year costs allocable to the diseases in question.

A conceptual framework and systematic methodology for measuring the single-year costs of all causes of death and illness will also provide comparable annual cost data for the major illness categories which can be the first step in future economic analyses for health program planning purposes. Measurement of the economic benefits derived from a program against the costs of engaging

Table 10—Annual economic costs: total amount with and without housewives' output, by type of cost, 1963

Type of cost	Amount (millions)		Per cent	
	including housewives' output	excluding housewives' output	including housewives' output	excluding housewives' output
Total	$58,036	$55,156	100.0	100.0
Direct expenditures	34,263	34,263	59.0	62.1
Indirect costs	23,773	20,893	41.0	37.9
mortality	2,731	2,012	4.7	3.6
morbidity	21,042	18,881	36.3	34.2

or investing in that program—the cost-benefit analysis—is of considerable current interest to the Administration.[19] In cost-benefit analysis as applied to the health field, the total cost of the disease serves as the measure of benefits derived from preventing or eradicating the disease.[20] The starting point is to determine the direct and indirect losses in a given year, as developed in this paper. From the economists' point of view, single-year cost estimates are generally not considered adequate evaluation measures for program planning for they represent only a portion of the estimated losses in output resulting from illness, disability, and death, seriously underestimating the size of the economic problem. If an individual had not died or become ill in this year, he would have continued to be productive for a number of years. It is the present value of these future losses that is required as an appropriate evaluation measure of the costs of a disease for program planning purposes. Only when the calculated pay-off period for a program investment is brief, can the single-year estimates of illness costs be used to measure the benefits.[21]

The cost-benefit studies of particular diseases that are currently available either lack comparative information or provide such information only about the relative benefits of some few diseases.[22] For the development of cost-benefit studies for specific long-term programs to control or eradicate disease, the data presented in this paper can serve as the first important step in the required calculations. Additional work must follow to obtain estimates of the *total* economic losses attributed to disability and illness. For mortality, the estimated value of all deaths is the product of the number of deaths and the expected value of an individual's future earnings by sex and age.[23] This method of derivation is laborious, taking into account the changing pattern of earnings

at successive ages, varying labor-force participation rates, work-life expectancy for different age and sex groups, and the appropriate discount rate to convert a stream of costs or benefits into its present worth. (The author has developed data for this phase of the study since this paper was submitted for publication; the findings are reported in "Estimating the Cost of Illness." Health Economics Series No. 6, US Department of Health, Education, and Welfare, PHS Publication No. 947-6.)

There are a number of problems of direct concern to the epidemiologist which affect future economic analyses. In order to estimate the present value of future losses resulting from morbidity, longitudinal data are required on the patterns of illness by diagnosis. If a particular illness strikes an individual in the early years of his working life, how will this affect his productivity in future years? Some illnesses may totally incapacitate him for part of his life, others may prevent him from working all of his life, still others may result in a lifetime of partial disability. Although a person cannot die twice, he can be ill or disabled from the same disease more than once.[24] Armed with longitudinal data relating to morbidity patterns by diagnosis, the economist can apply his economic tools to assess the total economic impact of morbidity from specific illnesses.

Another problem of common concern to the epidemiologist and the economist is the presence of multiple illnesses. However, each is concerned with different aspects of the problem. When multiple conditions are reported, the epidemiologist is concerned with the difficulties in proper measurement of the effect on each condition or disease of the various demographic, social, and economic factors.[25] For the economist, multiple conditions present difficulties in measurement of the economic aspects of each contributing disease or condition.

Several technical measurement problems were briefly outlined in this paper. When a person is suffering from more than one disease at the same time, his costs of medical care and production losses cannot be clearly identified with one disease. The presence of multiple diseases results in an overstatement of the cost of any single disease when the economic costs are measured separately. There is a consensus among economists that the total indirect costs of individual diseases cannot be added together to estimate the total costs of disease to society.[26]

In summary, this paper outlined a methodological framework for the calculation of single-year costs of illness, disease, and death. Data were presented on the direct and indirect costs of morbidity and mortality for the major diagnostic groups. Also summarized were the economic principles used, including use of earnings as the measure of output loss, assumption of labor force participation rates and conditions of high employment, inclusion of loss of output of housewives by application of imputed earnings, the omission of transfer payments and taxes for reasons of double counting, and the measurement, or lack of measurement, of intangibles. Several methodological problems were discussed, such as the presence of multiple diseases, measurement of mortality losses, the population groups for whom losses were calculated, and, finally, gaps in statistical data. The final section of this paper summarized the suggestions for use of these single-year data on illness costs.

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Fellowship in the APHA

The attention of members of APHA is drawn to Association News in the February, 1967, issue of the Journal. This sets forth the eligibility requirements for Fellowship in the APHA, explains the procedure for applying (blank forms are available from the headquarters office), and describes the privileges conferred by Fellowship.

Members are encouraged to take the initiative in applying for Fellowship. Members so interested and Fellows wishing to stimulate others to apply, are reminded that completed applications to be considered this year must be filed with the Membership Department, APHA, 1740 Broadway, New York, N. Y. 10019, no later than July 15.